

Application No. 09/660,840

Filed: 9/13/00

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AMENDMENT TO THE CLAIMS

1. (Currently Amended) A miniature endoscope for orthopedic imaging comprising:
  - ~~a rigid~~ an optical waveguide that transmits an image, the waveguide having a diameter of less than 2 mm;
  - a handle removeably attached to the optical waveguide with a connector;
  - a sterile barrier that can be extended over the handle;
  - an optical ~~element~~ lens coupled to a distal end of the waveguide;
  - an optical relay mounted in the handle and that is optically coupled to a proximal end of the waveguide; and
  - an imaging device mounted in the handle at a proximal end of the optical relay that receives an image from the optical waveguide.
2. (Original) The miniature endoscope of Claim 1 wherein the endoscope has an outer diameter of 1.6 mm or less.
3. (Original) The miniature endoscope of Claim 1 wherein the waveguide has an outer diameter between 0.6 and 1.6 mm.
4. (Original) The miniature endoscope of Claim 1 wherein the endoscope further comprises an illumination channel and a binary phase ring which disperses light from the illumination channel.
5. (Original) The miniature endoscope of Claim 1 wherein the waveguide comprises a glass having a refractive index in the range between 1.6 and 1.9.
6. (Original) The miniature endoscope of Claim 1 wherein the

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waveguide comprises a glass rod.

7. (Previously Presented) The miniature endoscope of Claim 1 wherein the light absorbing layer comprises a thickness between 5 and 10  $\mu$  m.
8. (Previously Presented) The miniature endoscope of Claim 1 wherein the light absorbing layer comprises extramural absorption glass.
9. (Previously Presented) The miniature endoscope of Claim 1 wherein the light absorbing layer comprises a refractive index of 1.6 or less.
10. (Previously Presented) The miniature endoscope of Claim 1 further comprising an illumination channel having a wall thickness in a range of 0.1 mm and 0.2 mm.
11. (Previously Presented) The miniature endoscope of Claim 1 further comprising an illumination channel having a refractive index in a range between 1.4 and 1.6.
12. (Previously Presented) The miniature endoscope of Claim 1 further comprising an illumination channel outer sheath.
13. (Original) The miniature endoscope of Claim 12 wherein the outer sheath comprises a polyamide coating.
14. (Original) The miniature endoscope of Claim 13 wherein the polyamide coating has a thickness between 100 and 150  $\mu$  m.
15. (Original) The miniature endoscope of Claim 1 wherein the optical element comprises one or more lenses.
16. (Original) The miniature endoscope of Claim 1 wherein the

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optical element comprises a plastic lens.

17. (Original) The miniature endoscope of Claim 1 wherein the imaging device comprises a charge coupled device.
18. (Original) The miniature endoscope of Claim 1 wherein the endoscope further comprises a distal needle that penetrates tissue.
19. (Withdrawn) The miniature endoscope of Claim 1 wherein the optical element has a rectangular cross-sectional area.
20. (Withdrawn) The miniature endoscope of Claim I wherein the waveguide has a rectangular cross-sectional area.
21. (Withdrawn) The miniature endoscope of Claim 1 wherein the optical relay has a rectangular cross-sectional area.
22. (Previously Presented) The miniature endoscope of Claim 1 further comprising a display connected to the imaging device.
23. (Previously Presented) The miniature endoscope of Claim 1 further comprising an illumination channel that is optically coupled to a light source in the handle.
24. (Currently Amended) The miniature endoscope of Claim 1 further comprising a an optical coupler that connects the handle a light source to the optical waveguide.
25. (Currently Amended) The miniature endoscope of Claim 1 ~~further comprising a disposable sheath that extends over the handle~~ further comprising an illumination channel having a fiber optic device that concentrically surrounds the optical waveguide.

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26. (Currently Amended) The miniature endoscope of Claim 25 wherein the ~~sheath barrier~~ is attached to a rigid waveguide housing that is connected to the handle.
27. (Original) The miniature endoscope of Claim 1 further comprising a light source that is optically coupled to the optical waveguide.
28. (Currently Amended) A miniature endoscope for orthopedic imaging comprising:  
    ~~a rigid an~~ imaging channel having a diameter less than 2 mm, ~~and a light absorbing layer defining a channel boundary;~~  
    an illumination channel coupled to a light source;  
    a handle attached to the imaging channel and the illumination channel with a connector;  
    a sterile barrier that can be extended over the handle;  
    an optical element lens coupled to a distal end of the imaging channel;  
    an optical relay mounted in the handle and coupled to a proximal end of the imaging channel; and  
    an imaging device mounted in the handle and coupled to a proximal end of the optical relay.
29. (Original) The miniature endoscope of Claim 28 wherein the imaging device comprises a charge coupled device.
30. (Original) The miniature endoscope of Claim 28 wherein the imaging channel comprises a transparent material having a refractive index of at least 1.6.
31. (Original) The miniature endoscope of Claim 30 wherein the imaging light channel comprises a glass rod.

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32. (Original) The miniature endoscope of Claim 31 wherein the glass rod comprises an F2 or an F7 glass.
33. (Currently Amended) The miniature endoscope of Claim 28 ~~wherein the further comprising a light absorbing layer comprises a light absorbing glass.~~
34. (Withdrawn) The miniature endoscope of Claim 33 wherein the light absorbing layer comprises a B6-2 glass or a BG-4 glass.
35. (Original) The miniature endoscope of Claim 28 wherein the illumination channel is coupled to a light source.
36. (Original) The miniature endoscope of Claim 28 wherein the illumination channel comprises a material having a refractive index higher than the first layer and the second layer.
37. (Original) The miniature endoscope of Claim 28 wherein the illumination channel comprises a transparent material having a refractive index of at least 1.6.
38. (Original) The miniature endoscope of Claim 28 wherein the first layer and the second layer each have index of refraction of less than 1.6.
39. (Previously Presented) The miniature endoscope of Claim 28 wherein the endoscope has a display connected to the imaging device for laparoscopic or arthroscopic examination.
40. (Withdrawn) The miniature endoscope of Claim 28 wherein the optical element has a rectangular cross-sectional area.
41. (Withdrawn) The miniature endoscope of Claim 28 wherein the imaging channel has a rectangular cross-sectional area.

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42. (Withdrawn) The miniature endoscope of Claim 28 wherein the optical relay has a rectangular cross-sectional area.
43. (Withdrawn) A method of forming a reflective boundary on a glass channel for a microendoscope comprising the steps:  
    providing a glass channel for a microendoscope; providing a light absorbing material;  
    extruding the light absorbing material over the glass channel to form a reflective boundary on the glass channel.
44. (Withdrawn) The method of Claim 43 further comprising the step of using a fiber optic drawing process to extrude the light absorbing material over the glass channel.
45. (Withdrawn) The method of Claim 43 further comprising the step of using a bar-in-tube drawing process to extrude the light absorbing material over the glass channel.
46. (Withdrawn) A method of forming an image light channel for a microendoscope comprising the steps:  
    providing an illumination channel having a refractive index;  
    coating an inner surface and an outer surface of the illumination channel with a material having a refractive index lower than the illumination channel refractive index;  
    providing an image light channel for a microendoscope;  
    and  
    attaching the illumination channel to the image light channel.
47. (Withdrawn) The method of Claim 46 further comprising the step of using a tube-extrusion process for form the coatings on the

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illumination channel.

48. (Withdrawn) The method of Claim 46 further comprising the step of depositing a glass on the outer surface and the inner surface of the illumination channel.
49. (Withdrawn) The method of Claim 46 further comprising the step of using a bar-in-tube fiber drawing process to fuse the illumination channel to the image light channel.
50. (Withdrawn) A method of forming a cladding structure on an image light channel for a microendoscope comprising the steps:  
providing an image light channel;  
forming a material having an index of refraction on the image light channel that is lower than the index of refraction of the image light channel to form a first cladding; extruding an illumination channel over the first cladding on the image light channel; and  
forming a second cladding on the illumination channel.
51. (Currently Amended) A miniature endoscope for orthopedic imaging comprising:  
a handle having an imaging device, a light source and a first coupling element;  
a sterile barrier that can be extended over the handle;  
and  
a rigid probe removeably attached to the handle with a connector and having a diameter of less than 2 mm, a waveguide and a second coupling element that connects the rigid probe to the first coupling element such that the waveguide is optically coupled to the imaging device; and  
a lens at a distal end of the waveguide.

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52. (Withdrawn) The endoscope of Claim 51 further comprising:  
a beamsplitter mounted within the housing wherein the beam splitter directs light from the lighting source through a rod and lens assembly to an object such that the beam splitter receives light from an object through the rod and lens assembly and directs the light to the imaging device.
53. (Withdrawn) The endoscope of Claim 51 wherein the waveguide comprises a hollow channel.
54. (Withdrawn) The miniature endoscope of Claim 51 wherein the imaging device comprises a plurality of lenses and a polarizer.
55. (Withdrawn) The miniature endoscope of Claim 54 wherein the polarizer comprises a sheet polarizer.
56. (Withdrawn) The miniature endoscope of Claim 54 wherein the polarizer comprises a cross polarizer.
57. (Withdrawn) The miniature endoscope of Claim 56 wherein the cross polarizer comprises a first prism and a second prism.
58. (Withdrawn) The miniature endoscope of Claim 51 wherein the light source is coupled to a polarizer and a lens.
59. (Original) The miniature endoscope of Claim 51 wherein the light source is coupled to an illumination channel with a fiber optic element.
60. (Original) The miniature endoscope of Claim 51 wherein the probe comprises an annular illumination channel around the



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waveguide.

61. (Original) The miniature endoscope of Claim 51 wherein the light source comprises an external lamp.
62. (Original) The miniature endoscope of Claim 61 wherein the external lamp comprises a xenon light source.
63. (Currently Amended) The miniature endoscope of Claim 51 wherein the ~~endoscope further comprises a sheath~~ sterile barriers is attached to the probe and extending over the handle.
64. (Currently Amended) The miniature endoscope of Claim 63 wherein the ~~sheath comprises a sterile barrier~~ is attached to a disposable probe element.
65. (Original) The miniature endoscope of Claim 51 wherein the probe comprises a needle with a distal optical system.
66. (Original) The miniature endoscope of Claim 51 further comprising a cannula wherein the probe fits within the cannula.
67. (Previously Presented) The miniature endoscope of Claim 66 wherein the waveguide comprises a rod and lens assembly having a locking mechanism wherein the cannula locks onto the rod and lens assembly.
68. (Original) The miniature endoscope of Claim 66 wherein the cannula comprises an illumination channel.
69. (Original) The miniature endoscope of Claim 66 wherein the cannula further comprises a stylet.

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70. (Withdrawn) A method of using a miniature endoscope comprising:
- providing a base unit and a sheath assembly having a probe waveguide and a sterile barrier; and
  - attaching the sheath assembly to the base unit such that the sterile barrier extends over the base unit.
71. (Withdrawn) The method of Claim 70 further comprising providing a cannula and securing the cannula to the sheath assembly.
72. (Withdrawn) The method of Claim 70 further comprising providing a luer fitting on the sheath assembly.
73. (Withdrawn) The method of Claim 70 further comprising disposing of the sheath assembly after use and attaching a second sheath assembly to the base unit for further use.
74. (Withdrawn) The method of Claim 70 further comprising providing a probe waveguide having a hollow channel and a light absorbing channel wall.
75. (Withdrawn) The method of Claim 70 further comprising providing a base unit including a handle, an imaging device within the handle and a relay optical system that couples an image from the waveguide to the imaging device.
76. (Withdrawn) The method of Claim 70 further comprising providing a probe waveguide having a diameter of 2 mm or less.
77. (Withdrawn) The method of Claim 70 further comprising connecting the base unit to a display.

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78. (Withdrawn) The method of Claim 70 further comprising providing an annular illumination channel in the probe.
79. (Withdrawn) The method of Claim 70 further comprising providing a probe waveguide having a length between 2 cm and 10 cm.
80. (Withdrawn) The method of Claim 70 further comprising directing polarized light through the waveguide.